An Energy Efficiency Workshop & Exposition

Kansas City, Missouri

GEOTHERMAL HEAT PUMPS: GREEN FOR YOUR WALLET, GREEN FOR OUR PLANET

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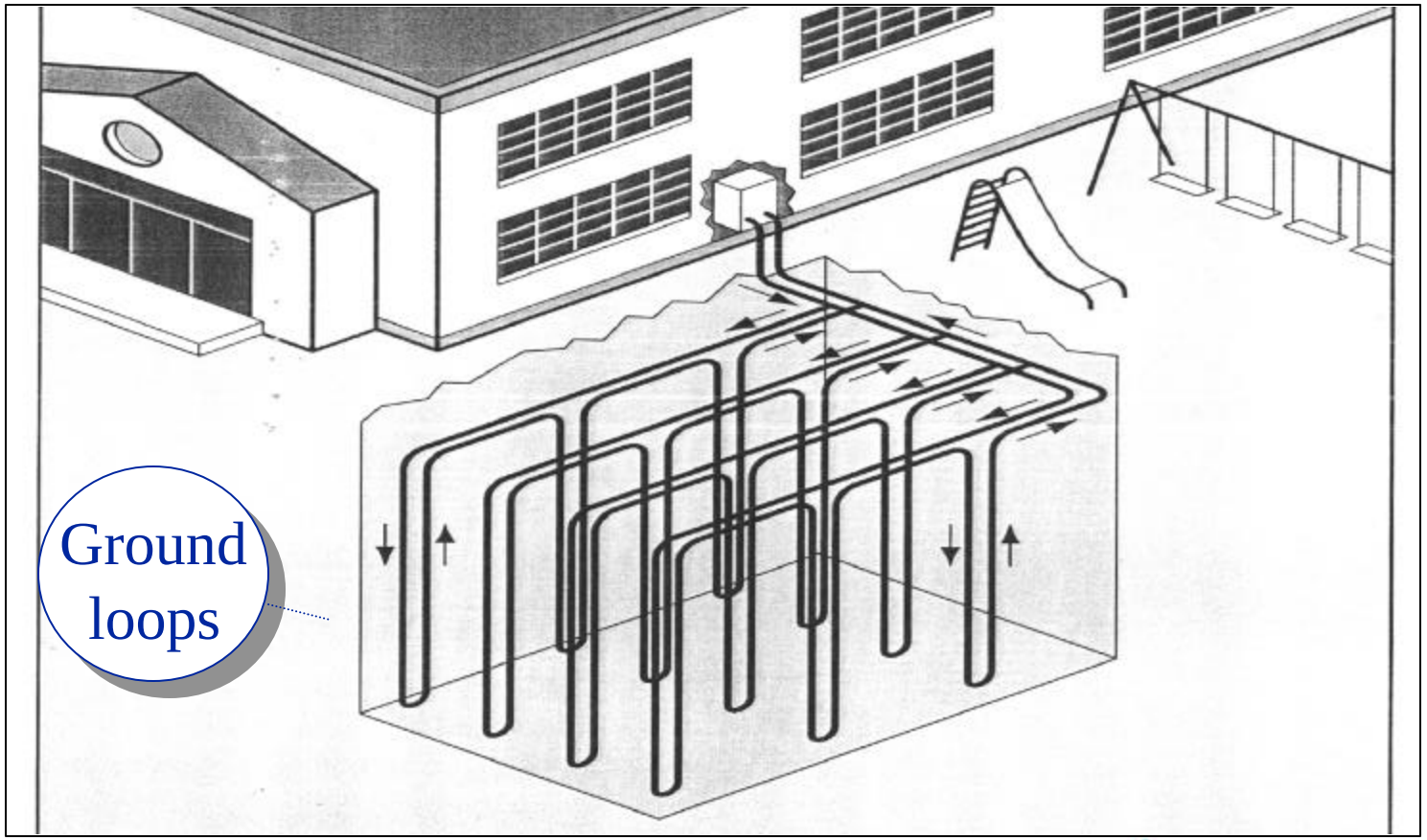
OUTLINE

- Overview of geothermal heat pumps (GHPs)
- Benefits of GHPs
- Trends in GHP marketplace
- Implementing a GHP system

INTRODUCTION TO GHPs

- **Not** a way to generate electricity from underground sources
- Like a conventional heating, ventilation, air conditioning (HVAC) system for buildings…
- …But, uses the ground – rather than the air – as the source or sink for heat
- Result: 30-70% higher system energy efficiencies than conventional HVAC

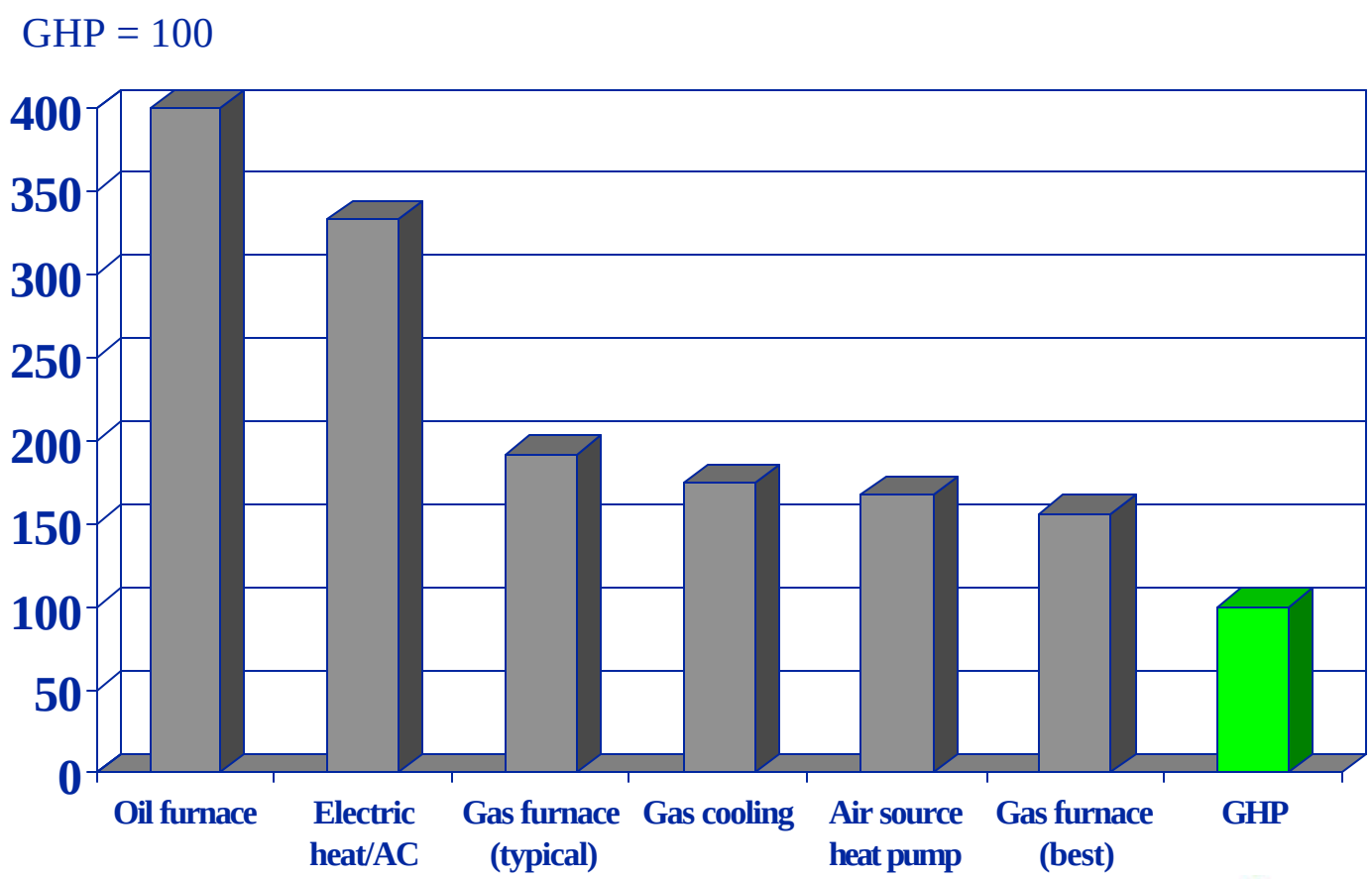
ILLUSTRATIVE GHP SYSTEM



GHPs: WELL-PROVEN

- Installations across U.S. since late 1940's
- About 500,000 installations throughout the U.S.
- 20+ year lifetime easily attainable

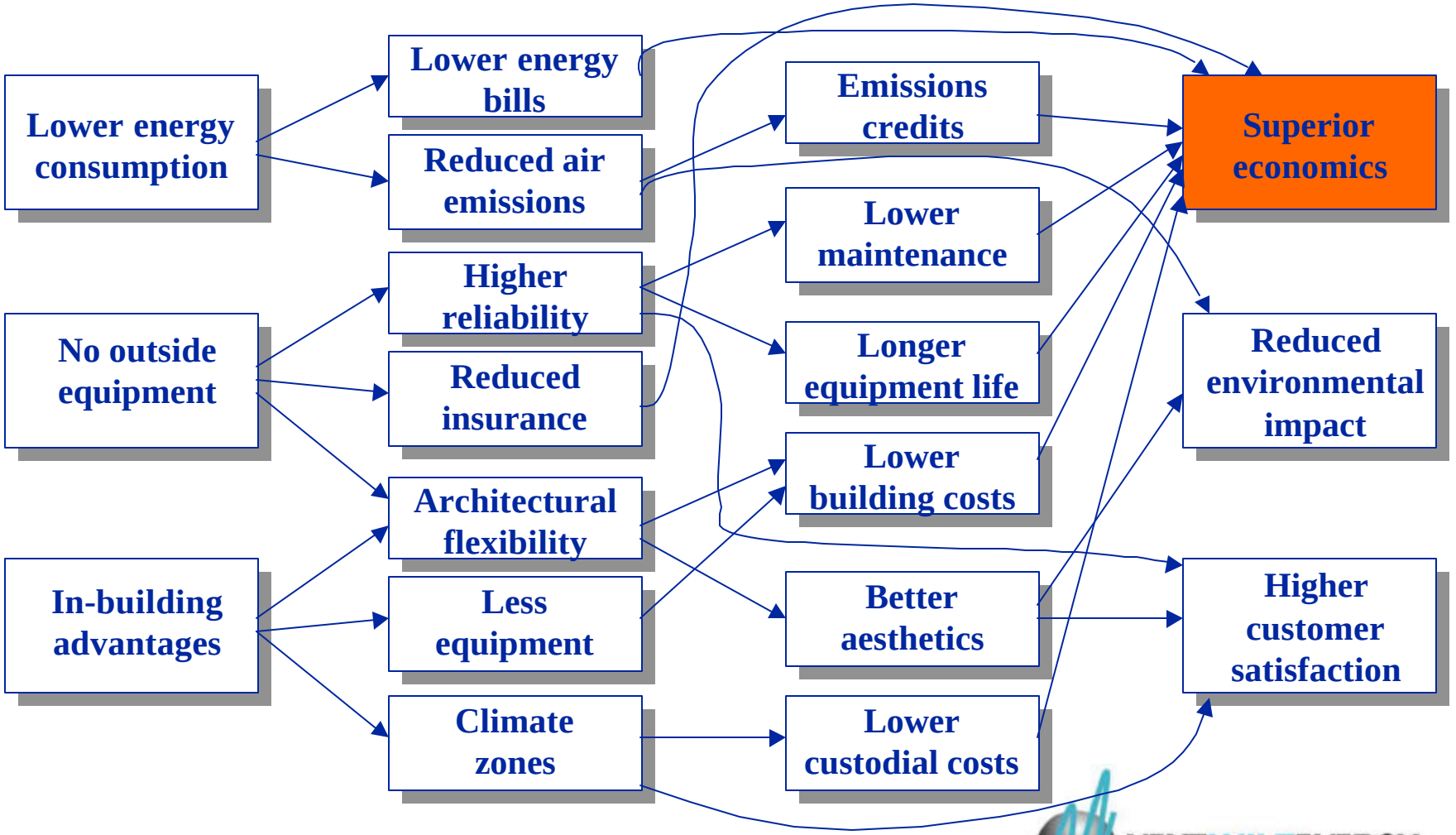
ENERGY CONSUMPTION OF HVAC ALTERNATIVES



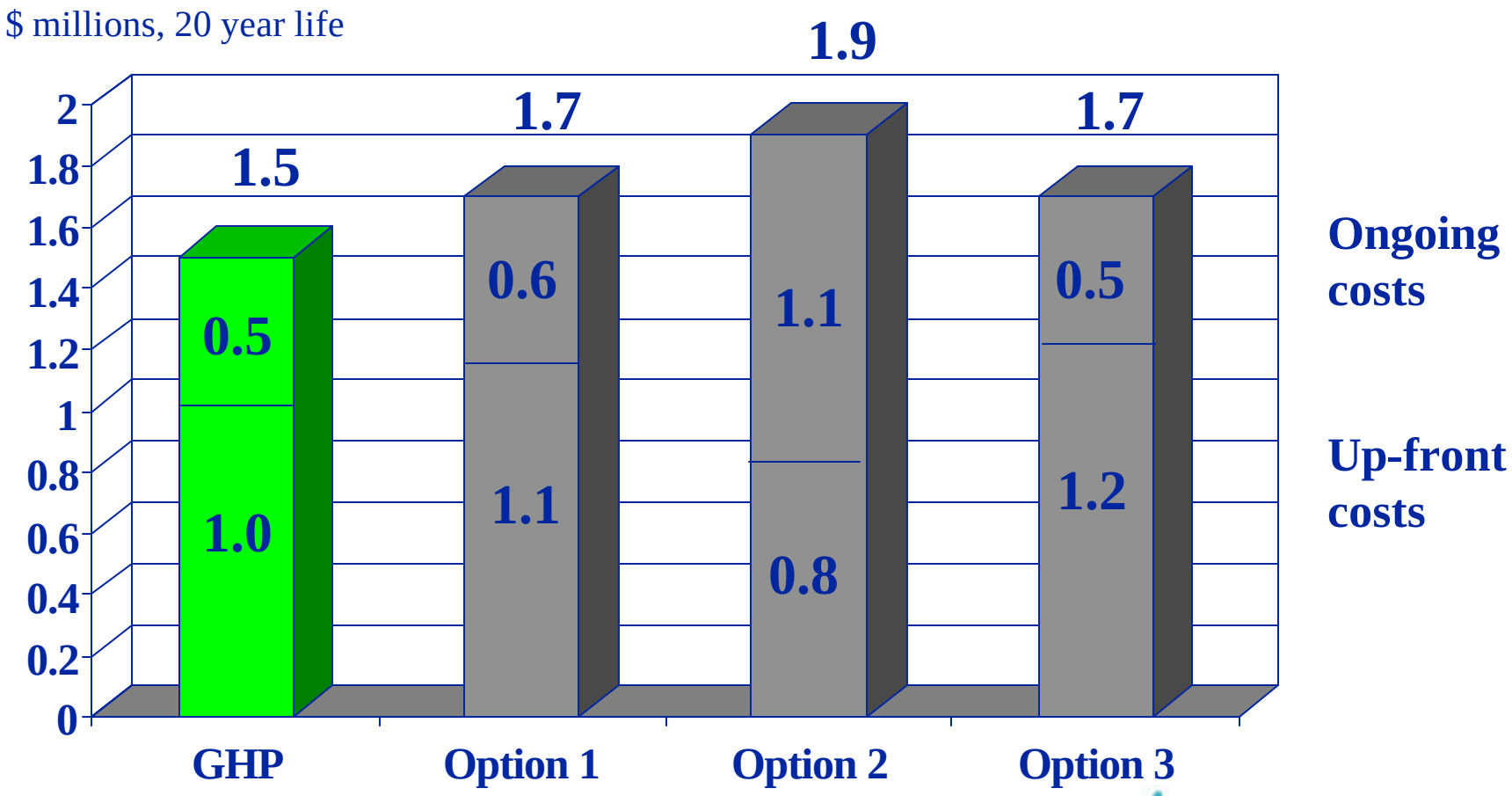
GHP: 30-70% lower than alternatives

Source: GHPC

BENEFITS OF GHPs



LOWER COSTS WITH GHPs: SCHOOL EXAMPLE



Source: Shonder, Hughes, McLain and Campbell

GHP PAYBACKS: N.Y. EXAMPLES

$ thousands

		GHP Costs		HVAC Costs				
Facility	HVAC Alternative	Up-Front	Annual	Up-Front	Annual	Up-Front Premium	Annual Savings	Payback (years)
Brewster H.S.	Gas boiler, 4 pipe system	$2,717	$121	$2,275	$193	$442	$72	6.1
Long Beach H.S.	Gas boiler + AC	$2,368	$129	$1,108	$285	$1,260	$156	8.1
Gore Mountain Summit Lodge	Electric heat	$305	$5	$167	$18	$138	$13	10.6

Source: GHPC

ENERGY SAVINGS: KEY DRIVER OF GHP ECONOMICS

Paybacks from GHP systems minimized at facilities that offer greatest potential for energy cost reductions

High prevailing energy prices

- Northeast
- Upper Midwest
- California

High energy consumption reduction potential

- High building utilization
- High cooling loads
- High hot water needs

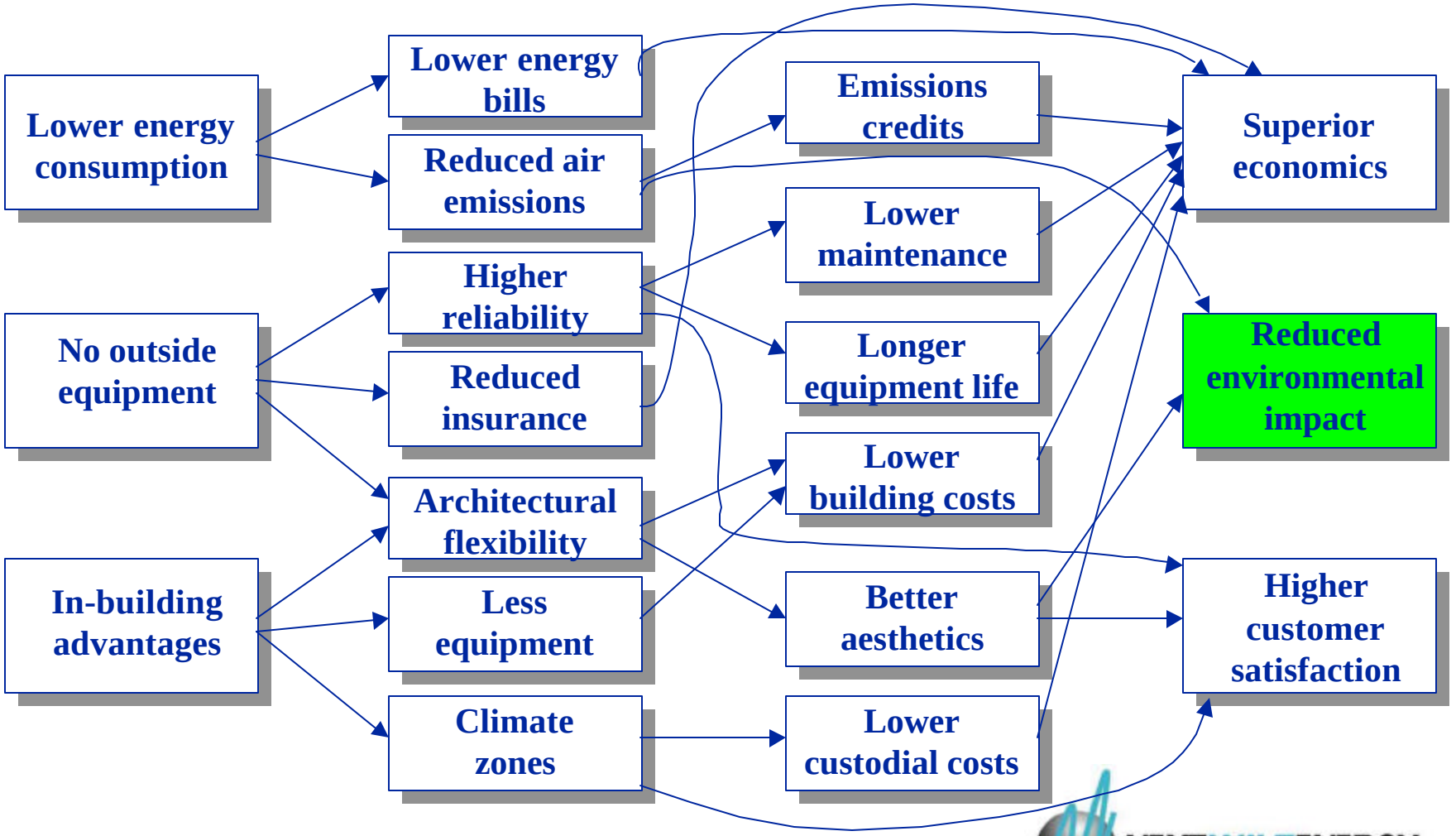
OTHER ECONOMIC BENEFITS

- Reduced up-front costs for building:
  - More useful internal space (either smaller building for same customer need, or more revenue for same footprint)
  - Less wasted space between floors, implying less overall building height (since pipes are smaller than ducts)
  - Less costly roof designs due to lower weight-bearing requirements (since no rooftop equipment)
  - Speedier building permitting / approval (where aesthetics are important)
- Reduced ongoing costs:
  - Lower maintenance costs
  - Longer equipment lifetimes (20 years), implying reduced / deferred replacement expenditures
  - Lower insurance costs (lower vandalism / safety risks, due to no outside equipment)
  - Lower custodial costs (greater ability for occupant to make temperature adjustments)

EMISSIONS CREDIT VALUE

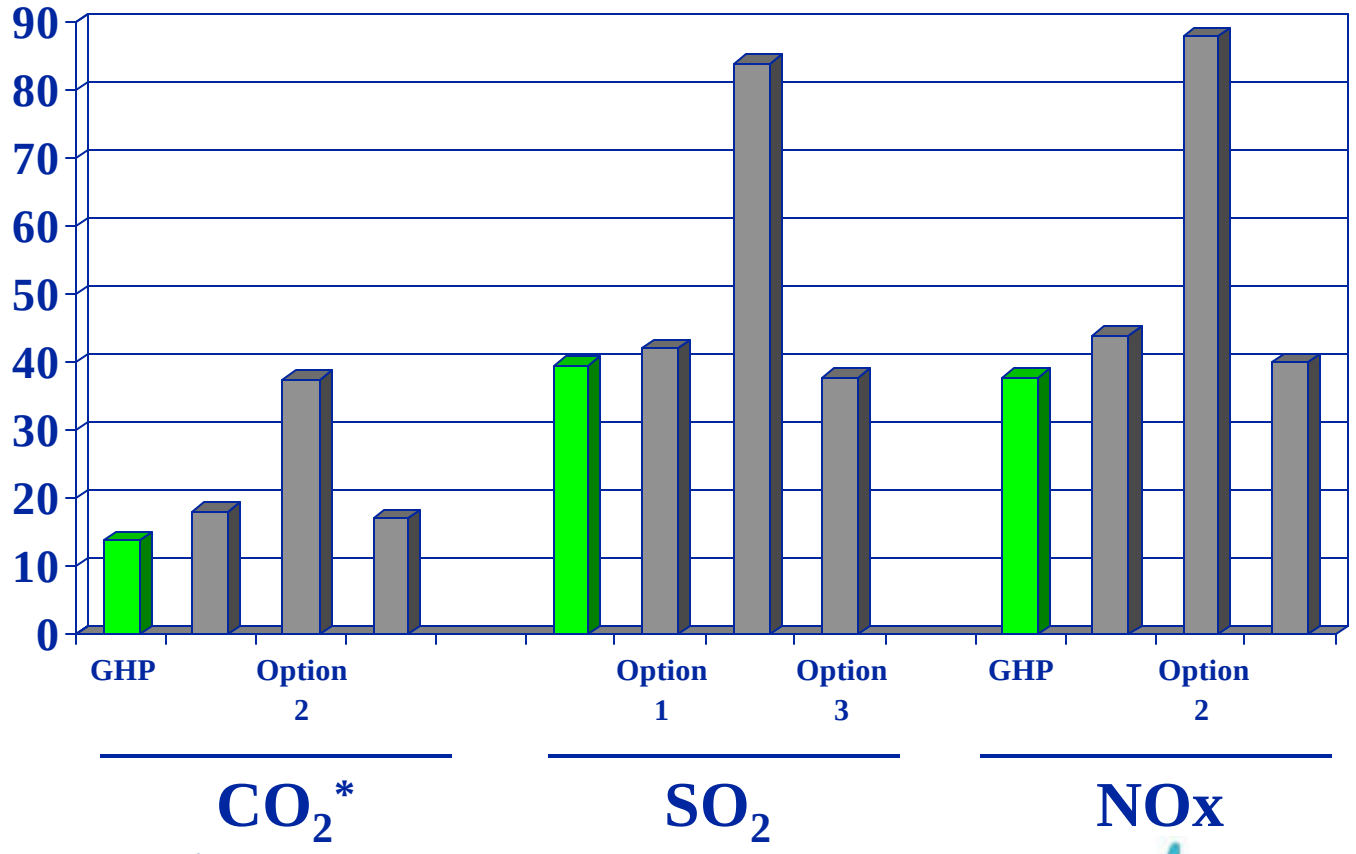
- Demonstrated emission reductions likely to become increasingly monetizable (and valuable):
  - State-specific credits (e.g., Texas)
  - International trading opportunities
- Since GHPs can reduce emissions significantly, an additional potential source of economic value may be available
- Quantification of GHP-based emission reductions required (e.g., EnLink)

BENEFITS OF GHPs



LOWER EMISSIONS WITH GHPs: SCHOOL EXAMPLE

Thousands of pounds*, 20 year life



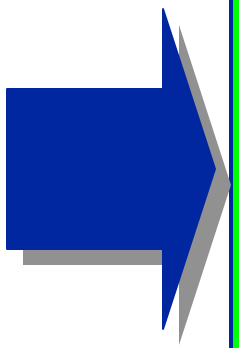
* CO_2 in millions of pounds

Source: Shonder, Hughes, McLain and Campbell

EMISSIONS IMPACT FROM GHPs

Annual energy savings of installed GHPs

- 4 billion kwh
- 20 trillion Btus of fossil fuels

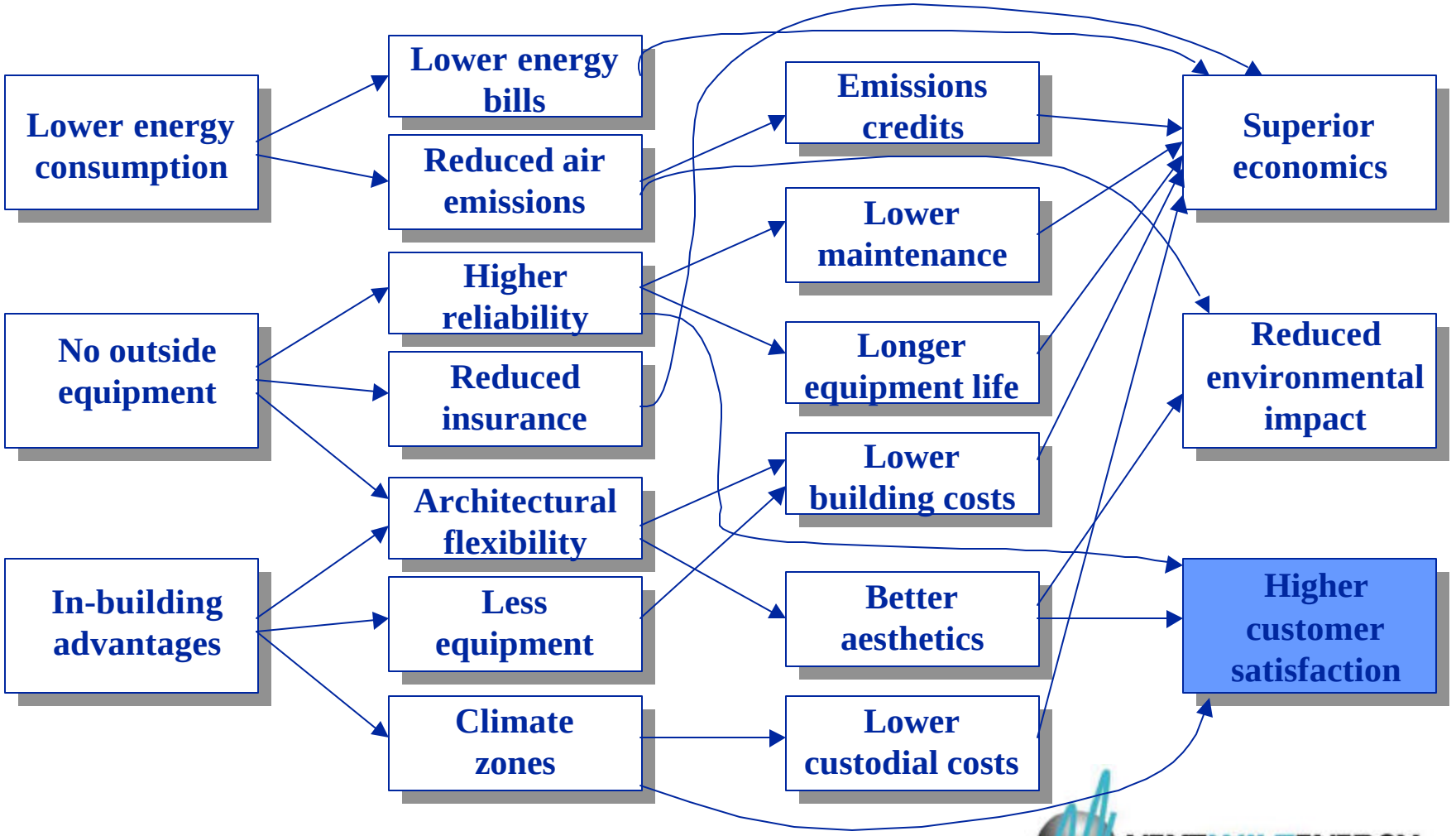


Environmental benefits: 3 million tons CO_2 reduced

- 650,000 cars
- 190 million trees (400,000 acres)

Source: GHPC

BENEFITS OF GHPs



ENHANCED CUSTOMER SATISFACTION WITH GHPs

- Higher reliability of HVAC service: fewer breakdowns causing disruption
- Better aesthetics of overall facility (no outside equipment)
- Enhanced ability to establish / maintain tailored climate zones

GHP SUCCESS STORIES

- **Fort Polk (LA)** – savings to Army of about $750K per year…plus much more reliable
- **Galt House Hotel (Louisville KY)** – annual energy bills about $300K lower…plus reduced O&M and additional usable space
- **Park Chase Apartments (Tulsa OK)** – reduction in annual utility bills of >$100K…plus increased tenant comfort and satisfaction

Source: GHPC

GHP TESTIMONIALS

"Geothermal heat pump technologies represent a major opportunity for reducing national energy use and pollution, while delivering comfort, reliability and savings."

- U.S. Environmental Protection Agency

"Geothermal heat pumps are among the most energy- and cost-efficient heating and cooling systems available today."

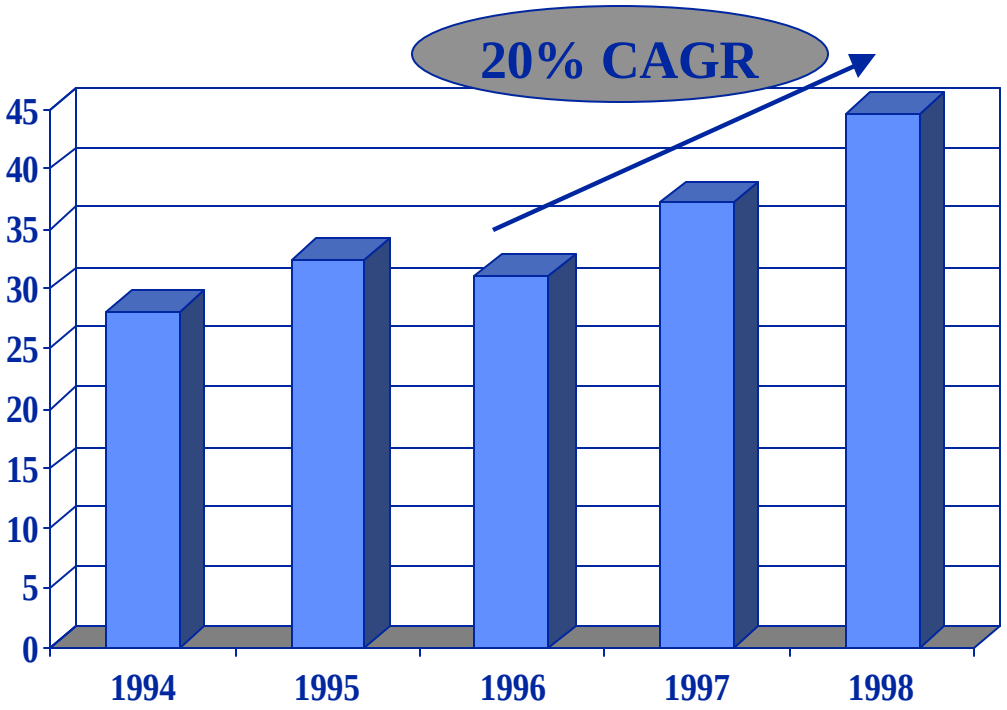
- U.S. Department of Energy

"If geothermal heat pumps were installed nationwide, they could save several billion dollars annually in energy costs and substantially reduce pollution."

- U.S. General Accounting Office

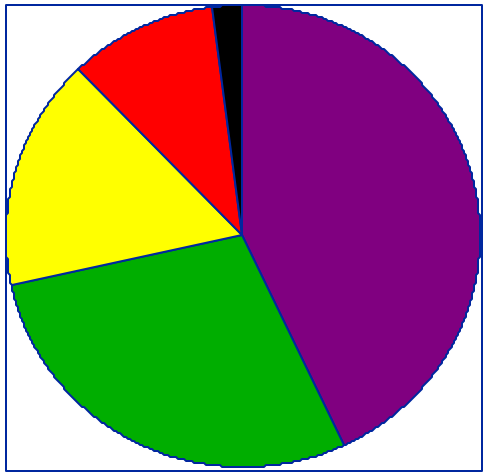
U.S. GHP SHIPMENTS

Thousands of units



Regional distribution of shipments (1997)

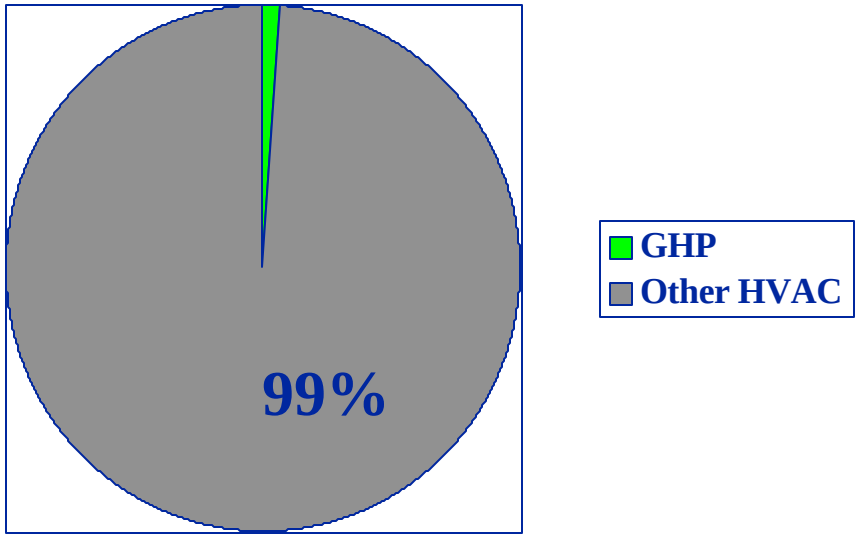
100% = 37,200



Source: U.S. DOE, GHPC

LIMITED GHP PENETRATION

Annual U.S. HVAC installations



Why so low?

- Low public awareness
- Higher up-front costs
- Limited installation network
- Few experienced architects / engineers

FUTURE EVOLUTION OF GHP MARKETPLACE?

- Continuing awareness-building programs
- Emphasis on reducing first-cost of ground loop fields (to improve paybacks)
- Development of "one-stop shops" for turnkey GHP solutions
  - Design and engineering
  - Installation (both "in the dirt" and in-building)

IMPLEMENTING A GHP SYSTEM

- Evaluate comparative economics for your specific facility
  - Building loads
  - Energy prices
  - Soil conditions
- Work with architect familiar with GHPs
- Select building contractor amenable to utilizing GHPs, i.e.:
  - Teams with engineers experienced in (or open-minded to) GHPs
  - Subcontracts an IGSHPA-certified system installer

INFORMATION ON GHPs

- Geothermal Heat Pump Consortium (GHPC): **www.geoexchange.org**
- International Ground Source Heat Pump Association (IGSHPA): **www.igshpa.okstate.edu**
- Geo-Heat Center:**www.oit.osshe.edu/~geoheat**

SUMMARY

- GHPs are a well-proven HVAC technology utilized across the U.S.
- GHPs offer many benefits – most notably, the ability to reduce costs and emissions associated with HVAC
- GHPs are often worth the extra effort to implement

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